NOTTINGHAM POWER RIG

1. Background and Rationale

The Nottingham Power Rig is designed to measure unilateral and bilateral leg extensor power, which is needed for many basic activities in daily life such as walking or rising from a seated position. Leg extensor power as measured using the Nottingham Power Rig has been shown to correlate well with functional measures such as chair-rising speed, stair-climbing speed and power, and walking speed in elderly subjects[1]. This measurement has been found safe and acceptable for all age groups and levels of physical capability[2,3].

2. Equipment and Supplies

- Nottingham Power rig
- 10 and 17 mm Allen wrenches
- AA batteries

2.1 Seat Adjustment
- Release blue seat clamps located behind the seat and atop the frame rails. This is the unlocked position.
- If necessary, rotate the chair 90 degrees to allow the participant to sit down easily, and place his or her feet on footrest.
- Rotate chair back inline with the frame rails so the participant faces the flywheel.
- **Ask the participant to slide his/her hips to the back of the seat so the back seat cushion is compressed while leaning slightly forward.** The hips should not rise up the seatback.
- While the seat remains in the unlocked position, the participant places one foot on the push pedal and leans slightly forward. The participant gently depresses the push pedal all the way down and continues to push until his/her leg is fully extended.
- Lock the seat into position by pushing the rear blue clamps. Make sure the clamp plates are in the correct position (i.e., there is an aligning pin which needs to be on the inside of the track.)
- While the participant's legs remain extended, measure the seat position using the affixed tape measure located on the participant's right side. Hook the tape measurer to the eyelet located under the right foot pedal. Record seat position or length to the nearest millimeter on participant's data collection sheet.
- The participant can then relax until testing begins.

2.2 Leg extensor power analyzer output
- Toggle switch to the on position on the analyzer.
- Depress the black reset button so the display reads "---."

2.3 Flywheel positioning
- Move push pedal to the full back position (toward participant).
- Rotate the flywheel so that the red dot is visible within the flywheel casing window, which is accessible through the opening at the bottom of the flywheel casing.

- Spin the flywheel in the opposite direction to remove the "slack."
- Move the break lever toward the participant, engaging the flywheel break to hold the starting position until the test begins.

3. Safety Issues and Exclusions

Participants with bilateral hip replacements in the past six months should not be tested. If participant had a hip replacement on one side, do not test that side. This information should be recorded on the data collection form.

4. Subject and Exam Room Preparation

4.1 Body positioning
- Ask the participant to cross their arms across their chest, with their back straight.
- Randomly select the first leg to be tested. Each leg will then be alternated through all trials.
- The participant places the selected foot on the push pedal so that the heel and instep are resting against the flanges (bottom and inside borders.)

4.2 Participant instructions
- Prior to setting up the apparatus for the participant, the investigator demonstrates testing procedures by performing the entire process twice.
- Describe the testing process as you demonstrate. Include the seat adjustment, foot placement practice test, and how maximal effort should feel.
- Instructions prior to the submaximal test are as follows: **"You will be pressing down on the push pedal with one leg at a time. We want you to have your entire foot on the pedal at all times; to do this, make sure you push through with your heel. Before starting, I want you to lean slightly forward, and cross your arms on your chest. This first time, push the pedal down at a moderate effort."** Make sure you correct poor form. Give verbal encouragement before and through the test. Repeat this test two times per leg. Make sure that the analyzer displays "----" before each trial. Do not record practice results.
- Instructions prior to the maximal test trials are as follows: "**Now we want to do the same thing, except at maximal effort. Push the pedal as though you are braking a car in an emergency situation. Remember this at 100% of your maximum. Lean slightly forward, and cross your arms on your chest. When I say 'go' push through with your heel and as hard and as fast as you can."**

4.3 Sub-maximal practice test
- The sub-maximal test is to be repeated three times per leg at moderate effort, increasing effort each trial.
- Double check to make sure the analyzer output displays "---" before each trial.
- Give verbal count down **"ready, set, go"** to signal the start of the test.
- The participant pushes the pedal at the described level. Reset the output analyzer.

5. Detailed Measurement Procedures

5.1 Performance test
- Make sure the participant is leaning slightly forward, and has his/her arms crossed across his/her chest. Double check to make sure analyzer output displays "---."
- Give verbal countdown as above.
- The participant pushes the pedal as hard and as fast as possible to full leg extension.
- Record power output (watts) in designated laboratory notebook.
- **Press reset button on power output display for the analyzer.**
- Repeat with nine trials on each leg (alternating legs each trial).

6. Procedures for Performing the Measurement at Home

Not applicable.

6. Alert Values/Follow-up/Reporting to Participants

None at this time.

8. Quality Assurance

8.1 Training Requirements

No special qualifications or experience are required to perform this assessment. Training should include:

- Read and study manual
- Attend Mr.OS training session on techniques (or observe administration by experienced examiner)
- Practice on other staff or volunteers (Goal: minimize differences between repeat measurements)
- Discuss problems and questions with local expert or QC officer

8.2 Certification Requirements

- Complete training requirements
- Demonstrate set-up procedures
- Conduct exam on 2 volunteers according to protocol, as demonstrated by completed QC checklist

8.3 Quality Assurance Checklist

Ñ Asks participant about hip replacements in the past six months and records appropriate information on data collection form.

Ñ Demonstrates and explains testing procedures to participant once before testing participant.

Ñ Performs seat adjustment according to protocol.

Ñ Records seat position to nearest mm on data collection form.

Ñ Correctly positions flywheel, according to instructions in the protocol.

Ñ Performs sub-maximal practice test on participant according to protocol:

  Ñ Positions participant according to the protocol.

  Ñ Verbal countdown prior to each trial.

  Ñ Gives verbal encouragement before and throughout the test.

  Ñ Repeats procedure twice per leg.

Ñ Performs maximal test trails according to protocol:

  Ñ Positions participant according to protocol.

  Ñ Checks that output displays "---" before beginning each trial.

  Ñ Verbal countdown prior to each trial.

  Ñ Gives verbal encouragement before and throughout the test.

  Ñ Repeats procedure nine times per leg, alternating legs.

  Ñ Records output correctly on data collection form.

9. References

1. Bassey EJ, Fiatarone MA, O'Neill EF, Kelly M, Evans WJ, Lewis A. Leg extensor power and functional performance in very old men and women. Clin Sci 1992; 82: 321-327.
2. Bassey EJ. Measurement of muscle strength and power. Muscle and Nerve 1997; supplement 5: S44-46.
3. Bassey EJ, Short AH. A new method for measuring power output in a single leg extension: feasibility, reliability and validity. Eur J Appl Physiol. 1990; 60: 385-390.